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September 17, 1999

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SEP 17 1999

FEDERAL COMMUNICATIONS COMMISSION
OFFICE OF THE SECRETARY

Re: WT Docket No. 97-81

Dear Ms. Salas:

On behalf of East Bay Municipal Utility District, I enclose an original and four copies of its Comments in the above-captioned proceeding, along with an additional copy (file) to be time-stamped and returned to this Office. In addition, I also enclose a 3.5 diskette containing the Comments submitted herewith, and formatted consistent with Paragraph 39 of the Commission's Further Notice in this proceeding.

Kindly contact the undersigned or Jewell Elliott, Esq. of these offices to the extent there are questions or you require anything further.

Sincerely yours,



Curtis T. White

Enclosures

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Before the
Federal Communications Commission
Washington, DC 20554

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SEP 17 1999

FEDERAL COMMUNICATIONS COMMISSION
OFFICE OF THE SECRETARY

In the Matter of)

Amendment of the Commission's Rules)
Regarding Multiple Address Systems)
_____)

WT Docket No. 97-81

COMMENTS OF
EAST BAY MUNICIPAL UTILITY DISTRICT

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September 17, 1999

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SUMMARY

East Bay Municipal Utility District (interchangeably "EBMUD" and "District") is a water utility organized pursuant to the laws of the State of California. A publicly owned utility with a long history of efficiently managing its water resources and supplies, the District is governed by a seven (7) member Board of Directors publicly elected from wards within its service area. Its emphasis on preserving the region's resources is aptly described in its mission statement, to wit:

To manage the natural resources with which the District is entrusted, to provide reliable, high quality water and wastewater services to the people of the East Bay, and to preserve and protect the environment for future generations.

EBMUD has been an active party in the MAS proceeding in that (i) it filed initial Comments in the first round; (ii) joined with various other parties in filing Joint Supplemental Comments in this matter on October 30, 1998; and (iii) as appropriate, and through counsel, participated in various *ex parte* meetings with Commissioners and/or staff.

Through these Comments, EBMUD explains how it relies heavily on its MAS communications grid and systems to ensure it fully and satisfactorily discharges its statutory obligation to provide potable water to its 1.3 million customers. It further explains how it uses the functionality and flexibility of its facilities to ensure adequate monitoring, management and control of its 300 water operation facilities, which extend over 325 sq. miles throughout its service area.

In offering comment on certain proposals contained in the instant *Further Notice*, EBMUD commends the Commission on and offers support for the following:

1. The appropriate recognition of need to ensure sufficient and unencumbered spectrum for "public safety" licensees/users, and the corresponding proposal to set aside five (5) of forty (40) channel pairs for public safety and Government use;
2. Adoption of the broader definition of "public safety radio services" for purposes of determining spectrum exempt from competitive bidding dictates set out in Section 309(j) of the 1993 Budget Act; and
3. Recognition of the need to ensure that the final outcome of this proceeding does not, in any manner, cause undue hardship or harm to existing licensees, particularly those – such as EBMUD – statutorily obligated to provide critical services directly related to the protection of safety, life and property.

EBMUD offers how it has established its OP/NET program as part of its Systems Strategic Planning process which is designed, *inter alia*, to maximize efficiencies and delivery of service, continue next century savings in energy costs, reduce or otherwise defer capital costs and improve security and maintenance. Above all, these efforts are intended to ensure that EBMUD provides safe and adequate supply of potable water to its customers.

The Comments also show even with maximum efforts to utilize existing resources and capacity, EBMUD is operating essentially at fully-loaded capacity and, as a result, requires additional MAS spectrum to address present needs and future demand.

Accordingly, EBMUD supports the proposed reservation of spectrum in the 932/941 MHz bands for public safety users, but also notes the Commission must ensure it must develops a mechanism or procedure which grants preference or priority for public safety users who are traditionally "Exempt" eligibles under Commission processing rules as well as those traditionally regarded as public safety categories as outlined in the Commission's rules.

EBMUD also agrees with the exemption of 928/952/956 MHz bands. In addition, however, it also recommends the Commission ensure that in designating the bands as "public safety radio services", it ensures licensees retain the flexibility to share their respective facilities as they deem appropriate or otherwise necessary.

Finally, EBMUD cautions the Commission "to do no harm" to incumbent licensees. In doing so, it urges the Commission to avoid promulgating, as part of this proceeding, any rule requiring incumbent licensees to downsize, reconfigure, relocate, recoordinate or in any other manner disturb its existing authorizations, operation or capacity. To do so, EBMUD submits, is both unnecessary and inconsistent with the public interest.

Before the
Federal Communications Commission
Washington, DC 20554

In the Matter of)	
)	
Amendment of the Commission's Rules)	WT Docket No. 97-81
Regarding Multiple Address Systems)	
_____)	

COMMENTS OF EAST BAY MUNICIPAL UTILITY DISTRICT

East Bay Municipal Utility District ("EBMUD/District"), by its attorneys and pursuant to Section 1.45 of the Commission's rules, 47 C.F.R. §1.45, hereby submits comments in response to spectrum allocation proposals governing Multiple Address Systems ("MAS"), set out by the Commission in its *Further Notice of Proposed Rule Making and Order* (FCC 99-101), released July 1, 1999 ("Further Notice"). In doing so, and because of its substantial reliance on MAS frequencies in the discharge of its statutory obligations, EBMUD offers its strong support for certain aspects of the Commission's licensing proposals, as follows:

1. The appropriate recognition of need to ensure sufficient and unencumbered spectrum for "public safety" licensees/users, and the corresponding proposal to set aside five (5) 40 channel pairs for public safety and Government use;
2. Adoption of the broader definition of "public safety radio services" for purposes of determining spectrum exempt from competitive bidding dictates set out in Section 309(j) of the 1993 Budget Act;¹ and

¹ Pub. L. No. 103-66, Title VI, § 6002(a), 107 Stat. 312, 387 (1993) ("1993 Budget Act")

3. Recognition of the need to ensure that the final outcome of this proceeding does not, in any manner, cause undue hardship or harm to existing licensees, particularly those – such as EBMUD – statutorily obligated to provide critical services directly related to the protection of safety, life and property.

I. INTRODUCTION

EBMUD was established under the Municipal Utility District Act of 1921, and currently operates pursuant to Section 11501, et seq., of the Public Utilities Code of the State of California. It has the statutory obligation of providing potable water service for its service area (covering approximately 325 square miles) and its 1.3 million customers.³

A publicly owned utility with a long history of efficiently managing its water resources and supplies, the District is governed by a seven (7) member Board of Directors publicly elected from the wards within its service area. Its emphasis on preserving the region's resources is aptly described in its mission statement, to wit:

To manage the natural resources with which the District is entrusted, to provide reliable, high quality water and wastewater services to the people of the East Bay, and to preserve and protect the environment for future generations.

³ The EBMUD water system serves 20 incorporated and 15 unincorporated communities. Incorporated cities include Alameda, Albany, Berkeley, Danville, El Cerrito, Emeryville, part of Hayward, Hercules, Lafayette, Moraga, Oakland, Orinda, Piedmont, Pinole, part of Pleasant Hill, Richmond, San Leandro, San Pablo, San Ramon and part of Walnut Creek. Unincorporated communities are Alamo, Ashland, Blackhawk, Castro Valley, Cherryland, Crockett, Diablo, El Sobrante, Fairview, Kensington, North Richmond, Oleum, Rodeo, San Lorenzo and Selby.

Its on-going operations include active water conservation and water reclamation programs; water distribution; wastewater treatment; a long range water supply management program which, *inter alia*, includes underground storage capacity for water during wet years for substitute use in dry years; and the development, management and protection of 54,000, plus, acres of watershed land.

With specific regard to the instant proceeding, EBMUD has been an active participant in that (i) it filed initial Comments, (ii) joined with various other parties in filing Joint Supplemental Comments in this matter on October 30, 1998; and (iii) as appropriate, and through counsel, participated in various *ex parte* meetings with Commissioners and staff.

In view of the foregoing, EBMUD submits it has a keen and substantial interest in this matter, and the ultimate outcome of Commission deliberations in this proceeding.

II. COMPETITIVE BIDDING IN THE MAS SPECTRUM

This initial Notice⁴ was issued in this proceeding as the Commission was grappling with its newly conferred auctions authority.⁵ Commencement here also coincided with the licensing of broadband Personal Communications Services, a proceeding which (at conclusion) had gained attention as the (then) largest public auction in U.S. history.

⁴ *Notice of Proposed Rule Making*, 12 FCC Rcd 7973 (1997)("First Notice")

⁵ *E.g.*, Implementation of Section 309(j) of the Communications Act - Competitive Bidding, PP Docket No. 93-253, *Notice of Proposed Rule Making*, 8 FCC Rcd 7635 (1993) ("*Competitive Bidding Notice*"). See also Implementation of Section 309(j) of the Communications Act - Competitive Bidding, PP Docket No. 93-253, *Second Report and Order*, 9 FCC Rcd 2348 (1994)("Competitive Bidding Second Report and Order"); Implementation of Section 309(j) of the Communications Act - Competitive Bidding, PP Docket No. 93-253, *Second Memorandum Opinion and Order*, 9 FCC Rcd 7245 (1994)("Competitive Bidding Second M O & O").

Thus it is against this backdrop – the newly conferred auction authority and soaring (and somewhat wildly inflated) license values – the Commission instituted proceedings in this Docket. In doing so, it appropriately set forth its reasons, which included as a primary objective the streamlining of "licensing procedures that provide licensees sufficient flexibility to use various technologies and offer a broad range of communications services."⁶

Equally relevant is the period January, 1992, during which the Commission opened a five-day window for filing MAS applications in the 932/941 bands and, in fact, received more than 50,000 applications within that five-day period. Under then applicable Commission licensing rules during, grant of licenses would have been governed by a random selection (lottery) process. However, the 1993 Budget Act was enacted into law and, as a result, the Commission began its time-sensitive and statutorily mandated implementation of certain provisions, including the design and promulgation of rules governing license auctions.

Under provisions in the 1993 Budget Act, the Commission was permitted to use competitive bidding for certain licenses and permits where the "principal use" of the spectrum was to provide "subscriber-based services", and an auction was in furtherance of the public interest.⁷ In that regard, and in its *Competitive Bidding Second Report and Order (supra)*, the Commission determined MAS spectrum did not qualify under the "subscriber-based" test and, as a result, determined MAS spectrum ineligible for auctions.

⁶ E.g., *First Notice* at 2.

⁷ E.g., 47 U.S.C. § 309(j)(1)-(3) (1996)(*Competitive Bidding Provisions*)

Subsequently, however, the Commission had an opportunity to review the applications filed during the five-day 1992 filing window, and discovered during that review the "vast majority" of license applications proposed "principal uses" generally related to the provision of "subscriber-based" services and, accordingly, issued this *Further Notice*.

Beyond the Commission revisiting the matter, Congress also adopted further modifications to the auction authority conferred under the 1993 Budget Act, which resulted in the elimination of Commission authority to grant licenses or permits by random selections subsequent to July 1, 1997.⁷

The Commission now concludes tentatively that some MAS licenses are subject to competitive bidding requirements since they involve "principal uses" of providing "subscriber-based services" (932/941 MHz),⁸ while some MAS spectrum appears exempt from competitive bidding requirements since they involve "public safety radio services" (928/952/956 MHz).⁹

III. EBMUD RELIES ON MAS SPECTRUM TO DISCHARGE STATUTORY OBLIGATIONS

EBMUD relies heavily on its Microwave communications grid and systems to ensure it fully and satisfactorily discharges its statutory obligations. In this regard, it currently has authority to and does operate fourteen (14) MAS Masters, with numerous remotes interrogating/responding facilities for each Master.

⁷ Pub. L. No. 105-33, Title III, 111 Stat. 251 (1997)("1997 Balanced Budget Act").

⁸ *Id* at ¶¶ 5 - 19.

⁹ *Id* at ¶ 20.

These facilities are used for various functions related to the District's day-to-day operations and to meet its statutory mandate of providing potable water for its customers, such as the monitoring of reservoirs and pumping plants operated by EBMUD. In addition, the systems are used as part of on-going programs to glean energy and historical data necessary for improving efficiencies and reducing overall costs.

Beyond general operating functions, the District also relies on the facilities to provide reliable and essential communications, as well as efficient operations of its water system during times of disaster. In this regard, the systems provide essential communications connectivity during power outages, windstorms, fires, earthquakes, as well as other disasters which have the potential of damaging property or life, or otherwise disrupting service to customers.¹¹

IV. EBMUD HAS INSUFFICIENT MAS SPECTRUM

EBMUD operates a number of MAS facilities as part of its water Operations Network (OP/NET). Of its MAS licenses, in excess of fifty percent (50%) operate at bandwidth of 25 kHz. Such operation is wholly consistent with the Commission's rule of flexibility, adopted as part of its comprehensive overhaul of the MAS spectrum in its 1988.

¹¹ Because EBMUD's service area and its microwave facilities are located in the Northern California area, many are located in wooded areas, some of which have been swept by fire within the last few years, which resulted in substantial damage to property and life. With its experience in coping in disasters, EBMUD has come to rely heavily and substantially on its Master radio communications capabilities, and to use same to monitor and control water facilities during emergencies when traditional wireline facilities often prove unreliable.

This revision of Part 94 of the Rules expressly permits flexibility in licensing in order to accommodate wider bandwidth as may be necessary to provide services and consistent with the efficient use of spectrum.¹²

The District has developed its water OPerations NETwork ("OP/NET") system, which focuses on maximizing reliability of the monitoring and control of its water system and the more than 300 water operation facilities spread throughout its service area (including its reservoirs, hydroelectric power plants, aqueducts, treatment plants, rate control valves and pumping plants).

Its initial OP/NET system was installed in the mid 1980s, and had a general life expectancy of 15 years. Because the District is subject to its budgeting requirements and processes, it is limited in its ability to support significant capital outlays in a short (one or two year) period. As a result, it uses its OP/NET program as a mechanism for ensuring a continuous technology update program, and does so within budgetary constraints. In sum, this multi-year, multi-million dollar program is designed, *inter alia*, to maximize efficiencies and delivery of service, continue next century savings in energy costs, reduce/defer capital costs, as well as improve security and maintenance.

From an operational perspective, the OP/NET system is an open architecture, integrated network which employs the skills of both EBMUD's staff and outside vendors and consultants, and which is designed as part of EBMUD's Systems Strategic Planning process.

¹² See Amendment of Part 94 of the Rules to Permit Intrasystem Communications Among Multiple Address System Master Stations, PR Docket no. 87-5, *Report and Order*, 3 FCC Rcd 1564 (1988).

It facilitates intra and inter-departmental planning and coordination. In addition, SCADA systems are major and critical components of the District's OP/NET system and, as with the overall approach, SCADA systems are also subject to continuous upgrading.

Thus it cannot be gainsaid that EBMUD's OP/NET system is anything less than critical to its management of water production, treatment and its distribution systems. With regard to energy, data yields are particularly relevant to Time-of-Use pumping, the use of which has resulted in substantial cost savings (over \$800,000) annually. From a data yield perspective, the OP/NET system gathers data on such matters as shutdown studies for Seismic Improvement Projects, vibration studies for predicting pump failures and turbidity studies.

With particular regard to water distribution and planning, the OP/NET system provides historical data on reservoir and system outages, and historical data is invaluable in the calibration of models to forecast emergency conditions. It is also used in hydrant testing and operating status, pressure zone investigations, unaccounted water studies (gross v. demand), and to meet water reporting regulations.

Beyond routine operations, the yielding of historical data necessary for forecasting, and promoting greater administrative and operational cooperation, the OP/NET system is critical to the provision of services and protection of property and life during times of emergency.

Because of current operational requirements, most of EBMUD's MAS facilities are operating at or near full capacity, and this will only be exacerbated in the near future given the continuous upgrading requirements under its OP/NET plan.

V. **CONGRESS EXPRESSLY INCLUDED CRITICAL INFRASTRUCTURE LICENSEES (AS EBMUD) UNDER ITS BROADENED DEFINITION OF "PUBLIC SAFETY" USERS**

When the Commission instituted this proceeding, it noted it was prompted by various considerations, including (i) how to provide opportunities for continued development of competitive new service offerings; (ii) how to expedite market entry (for new entrants and services); and (iii) to promote technological innovation.¹³ Since that issuance was almost contemporaneously with the mid-cycle of auctions in the PCS band,¹⁴ it is reasonable to conclude that one additional likely consideration at the time this proceeding was noticed-out is the fact that some MAS spectrum, particularly in light of the 50,000 applications in the 932/941 band, qualified for auction under guidelines laid out in the 1993 Budget Act.

Also in 1997, Congress had come to recognize the need to ensure that spectrum used by industries in the safeguarding of life, health and property should not be subject to the Commission's auction authority. Accordingly, it exempted "public safety radio services" under the 1997 Budget Act.¹⁵ In doing so, Congress determined that because such licenses are used by, among others, utilities (including water) to protect life, health and property, the public interest required such spectrum be left undisturbed by any auction activity. Thus, as Congress was expanding the reach of auctionable spectrum, it simultaneously barred the inclusion of spectrum used by public safety entities.

¹³ *NPRM* at 2.

¹⁴ The Commission concluded its initial PCS auctions for Blocks A & B on March 13, 1995, which generated overall revenues of \$7.7 billion. Subsequent auctions were also held, which culminated, initially, with the 1996 auctions covering Blocks D, E & F.

¹⁵ Balanced Budget Act at Title III, § 3002.

Through this exemption, Congress also made clear its express intent to include Critical Infrastructure Industry providers, such as EBMUD – namely those using private internal radio systems to provide services that protect life, health and property – under this exemption.¹⁶

Beyond the language contained in the House Report, the Commission itself had also recognized the public safety nature of utilities in Docket No. 92-235 (the Refarming Docket), and provided special coordination protection for such services in the outcome of that proceeding.¹⁷

Moreover, the President's Commission on Critical Infrastructure Protection also sets out the view that Critical Infrastructure Industries, for national policy reasons, must enjoy protection from unnecessary or avoidable disruptions.¹⁸

Finally, and appropriately, the Commission's embraces the express language in the 1997 Budget Act when it notes that "public safety radio services" "are those defined to include 'private internal radio services' used by State and local governments and non-government entities including emergency road services provided by not-for-profit organizations, that – (i) are used to protect the safety of life, health or property; and (ii) are not made commercially available to the public."¹⁹

¹⁶ E.g., H.R. Rep. No. 105-217 at 572 (1997).

¹⁷ *Second Report and Order*, PR Docket No. 92-125, 12 FCC Rcd 14307 (1997).

¹⁸ *President's Commission on Critical Infrastructure Protection* (1997).

¹⁹ *Further Notice* at ¶ 18.

VI. EBMUD SUPPORTS CERTAIN LICENSING PROPOSALS

EBMUD commends the Commission on its recognition of the need to ensure that additional spectrum is made available for Critical Infrastructure Industry licensees such as EBMUD and, further, to exempt from auction spectrum specifically or predominantly used for the purpose of providing services which related to the protection of life, health and property.

A. Set-Aside In 932/941 MHz Bands

The Commission has determined the vast majority of applications filed under the 1992 five-day filing window had proposed as "principal use" the provision of "subscriber-based" services. Based on that conclusion, the Commission, pursuant to its authority and dictates contained in the 1993 and 1997 Budget Acts, respectively, has proposed to auction spectrum in the 932/941 MHz bands.²⁰ Additionally, and while it has reached no tentative conclusion on the matter, the Commission also requests comment on the question of whether there should be a reservation in the 932/941 band for public safety radio services (the broadened definition of users) as part of this proceeding. In raising that question, the Commission notes its belief that "...such an approach may effectively afford both public safety and non-public safety users access to these unencumbered bands and further the Congressional intent of increasing the public safety community's access to frequencies without having to compete in an auction."²¹

²⁰ Further Notice ¶¶ 19 - 20.

²¹ *Id* at ¶ 22.

EBMUD strongly supports a set-aside of spectrum in the 932/941 MHz for public safety radio services, although it questions whether the amount or percentage (represented by 5 of the 40 channels)²² will be sufficient to meet the current requirements for public safety users. Accordingly, it would urge the Commission to undertake a further assessment in this regard, and in an effort to ensure that the percentage/amount proposed will satisfy current needs (as well as immediately projected) future requirements. This is particularly relevant in view of the fact that in many areas throughout the country, MAS facilities often are required to compete with common carrier facilities operating in the 932/941 MHz band.²³

EBMUD recommends further that the Commission develop a mechanism and/or procedure which grants preference or priority for public safety users who are traditionally "Exempt" eligibles under Commission processing rules and/or those traditionally regarded as public safety categories as outlined in the Commission's rules. To do so, EBMUD submits, would be consistent with Congressional intent and, moreover, in furtherance of the public interest.

B. Exemption of 928/952/956 MHz Bands From Competitive Bidding

In addition to offering its strong, yet qualified, support for the set-aside of spectrum in the 932/941 band for public safety users, EBMUD also offers its support for reserving the 928/952/956 MHz bands for public safety radio services.

²² *Id* at ¶ 22.

²³ *E.g.*, 47 C.F.R. 22.531.

The Commission indicates it must determine – whether through comments offered herein or some other procedure – the level of representation of "public safety radio services" in the band as defined by the Balanced Budget Act of 1997.²³

EBMUD offers the following comments regarding its use of its MAS facilities in the subject band:

As a drinking water utility, EBMUD relies on its systems to perform a number of functions directly related to its statutory obligation to ensure and otherwise provide a safe and adequate supply of potable water to its users. Key to the operation and management of its OP/NET system, *infra*, is its use of SCADA.

In broad terms, and part of EBMUD's System Strategic Planning, its MAS systems are used to increase source protection, collect historic data helpful to controlling overall energy costs and assess preparation for emergency conditions and disasters, promote greater coordination by and among its staff, develop forecast models, conduct water studies and satisfy water reporting regulations.

In view of the foregoing, EBMUD submits its public safety services are readily and appropriately categorized under the traditional "public safety radio services", and requests that the Commission so note this classification as may be appropriate.

Finally, and to the extent the Commission does classify the subject 928/952/956 bands as "public safety radio services" band, it must also ensure it provides adequate flexibility among the licensees to share, as may be necessary, their respective facilities.

²³ *Id* at ¶ 20.

VII. THE COMMISSION MUST TAKE SPECIAL PRECAUTIONS TO ENSURE ACTIONS IN THIS DOCKET DO NOT HARM OR OTHERWISE CREATE UNDUE HARDSHIP FOR INCUMBENT LICENSEES

Public safety licensees are engaged in day-to-day operations which require it to provide services directly related to the protection of life, health and safety. The Commission must bear this fundamental consideration in mind as it fashions its final rules for the instant proceeding, and EBMUD has specific concerns in this regard.

At the outset, EBMUD would strongly urge the Commission that it not consider or promulgate any rule requiring incumbent licensees to downsize, reconfigure, relocate, recoordinate, or in any other manner disturb its existing authorizations, operation or capacity. To do so, EBMUD submits, would cause undue harm and, further, is unnecessary to satisfy Congressional intent or Commission objectives and, moreover, is inconsistent with the public interest.

Additionally, EBMUD urges the Commission to develop an interim policy or procedure which permits incumbent licensees to modify their MAS facilities during the pendency of this proceeding and issuance of the Commission's Final Order. This request arises out of the simple and understandable fact that incumbent licensees are required to conduct its business affairs even as this proceeding goes forward, which in various instances conceivably requires modifications generally acceptable under Commission processing standards, though nonetheless regarded (in a technical sense) as a major modification under the rules.

VIII. CONCLUSION

EBMUD urges the Commission to reserve spectrum in the 932/941 bands for public safety radio services, and to grant preference or priority to public safety users who are "Exempt" eligibles under Commission processing rules as well as those traditionally regarded as public safety categories as outlined in the Commission's rules.

Additionally, EBMUD agrees with the proposal to designate the 928/952/956 bands as the "public safety radio services" band, thus exempting them from competitive bidding requirements. In doing so, however, EBMUD also urges the Commission to ensure that it retains flexibility in the rules which permits licensees to share their respective facilities as they deem necessary or appropriate.

Finally, EBMUD strongly urges the Commission to take special precautions to ensure its actions in this Docket do not harm or otherwise create undue hardship for incumbent licensees.

Respectfully submitted,

EAST BAY MUNICIPAL UTILITY DISTRICT

By: 

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September 17, 1999

OP/NET PLAN OF EAST BAY MUNICIPAL UTILITY DISTRICT

OP/NET SYSTEM PLAN

By

**Joseph A. Young
David L. Browne
Bryan C. Dilts
Thinh T. Vo
Kevin B. Wong
Richard P. Wyman**

January 1997

OP/NET System Plan
Revised 27 Jan 97
EXECUTIVE SUMMARY

INTRODUCTION:

The water Operations NETwork (OP/NET) Computer System was installed in the mid-1980s with an expected life of 15 years. Consequently, around the year 2000 many components will need replacement. The goal of the OP/NET System was to have a monitoring and control system with 99.9% up time reliability for the 300 water operation facilities spread out over 5 counties. These facilities include reservoirs, hydroelectric power plants, aqueducts, treatment plants, rate control valves, and pumping plants. The OP/NET System has made daily and emergency operations more effective and efficient. Water Quality, Planning, Engineering, Maintenance, and other District office staff also use information provided from the OP/NET System to help make their work easier and better.

When the original OP/NET System was installed during 2 years, both the technical support staff and operators helped oversee and checkout the initial installation. The turnkey contract cost \$15.3M but District staff time for planning, contract administration, and training cost \$9.7M. However, today these District folks are busy operating and maintaining the system and would not be able to devote full time support to a similar short duration complete replacement of OP/NET System hardware and software. In 1993 the OP/NET System Capacity Improvement (OSCI) Project added \$1.5M of networking equipment, servers, and workstations which shifted the historical archiving function from the OCC computers to the two new servers and allowed all 13 Water Operations Office locations to view the same displays available to the central OCC Operator. This effort brought the total capitalized cost of the OP/NET System to \$27M.

The ability of the District to budgetarily support large capital outlays in 1 or 2 years is severely limited. Consequently a new way of supporting the upgrade of the various components of the OP/NET System is needed. A way to keep up with changing technology without periodic balloon payments would be ideal.

RECOMMENDATION:

The recommended plan is to have a continuous replacement and upgrade program to replace the OP/NET System's aging components and subsystems. The total costs will be consistent with the existing 5-year Plan but more evenly distributed throughout the years.

The recommended continuous program is preferable to the two major alternatives for the reasons stated below:

- Doing nothing will result in increased maintenance costs and some unrepairable breakdowns because of vendors withdrawing support for obsolete hardware products and software.
- Performing a 2 year changeover would result in a lump sum \$12 Million project which would be difficult to get budget approval for and which would require 8 extra staff to support the project for a 2 year period.

PLAN SUMMARY:

The OP/NET System continuous replacement and component upgrade project approach supports the District's Mission by providing responsive customer service, exercising responsible financial management, and promoting a healthy work environment.

The benefits are ability to run and upgrade parts of the system and minimize staff increases while also continuing into the next century savings in electrical energy costs, reduced and deferred capital costs, quicker emergency response, fewer water outages, improved system security, reduced pressure surges, improved water quality, improved preventive maintenance, and automated report and database generation.

The staffing consists of existing District staff assisted by various consultants and vendors for specific tasks. See attached cash flow spreadsheet and schedules for details of activities for each Fiscal Year.

In accord with the District Information Systems Strategic Plan and the Water Operations Information Systems Strategic Plan the intent is to end up with a new Control System that is open and utilizes the District standard ORACLE database.

This will allow coordination with other departments using data from the OP/NET System. In addition the open systems will support continuous upgrade and maintenance process for the computer system components.

DRIVING FORCES:

The OP/NET System with a capitalized cost of \$27 Million relies on computer maintenance support by the vendor. The current OP/NET System was planned in 1985 to have a 15 year life. Various components have stopped being supported or have been announced by their vendors to be obsolete. The critical one is the Fisher SCADA Software. After October 1999, Fisher will no longer offer software Support Agreements. Hewlett-Packard has also announced dates when their equipment and software support will cease just after the turn of the century.

In short, the OP/NET System hardware and software is already obsolete and needs replacement soon

Maintenance costs on the existing system will increase if the obsolete components are not replaced. Some other water utilities which did not upgrade their systems are now looking for surplus used equipment as a source of spare parts and even performing electronic component replacement on printed circuit boards which is labor intensive and therefore very costly. In the extreme, if the system became completely inoperable, then the District would have to hire 25 additional pumping plant operators dispatched in trucks to operate the 130 pumping plants.

Yearly Cash Flow as of Tue 1/28/97
OP/NET System Plan

	1997	1998	1999	2000	2001	2002	2003	2004	Total
Replace PDMs									
Design	\$462	\$39							\$500
Construct		\$1,500							\$1,500
New Hardware/ software									
Plan	\$246	\$154							\$400
Design		\$485	\$35						\$500
Install			\$3,325	\$175					\$3,500
Start Up			\$280	\$420					\$700
AWWARF Energy /WQ mgmt Software									
Plan E/WQ	\$188	\$14							\$180
Design Forum	\$14	\$18							\$30
Replace HP RTUs				\$1,377	\$2,000	\$1,623			\$5,000
Continue Maint. & Upgrade of Open Arch OP/NET System						\$377	\$2,008	\$1,615	\$4,000
Total	\$887	\$2,188	\$3,640	\$1,972	\$2,000	\$2,000	\$2,008	\$1,615	\$16,310

ID	Task Name	Proj. Desc. & Justification	1997				1998				1999				2000				2001				2002				2003				2004				2005				2006				2007				2008				
			1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4													
1	Replace PDMs	Abandoned telco circuits, Unsupported equipment, Unreliable operation, High maintenance costs																																																	
4	New Hardware/ software	Replace aging computers and software w/ next generation open architecture systems & components																																																	
9	AWWARF Energy /WQ mgmt Software	Industry collaboration w/ other utilities to develop EM/WQ system for next generation SCADA																																																	
12	Replace HP RTUs	RTUs will reach the end of their design life and they will no longer be supported by HP (\$2000/yr)																																																	
13	Continue Maint. & Upgrade of Open Arch OP/NET	Prevent OP/NET obsolescence by adding & or upgrading hardware and software, upgrading RTUs & com. devices (\$2000/yr)																																																	

Project: OP/NET System Plan
Date: Tue 1/28/97

Task

Progress

Milestone

Summary

Rolled Up Task

Rolled Up Milestone

Rolled Up Progress

ID	Proj. Desc. & Justification	Cost	Pri. Resour	1997				1998				1999				2000				2001				2002				2003				2004				2005				2006				2007													
				1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4																		
1	Abandoned telco circuits, Unsupported equipment, Unreliable operation, High maintenance costs	\$2,000	Design & Contractor																																																						
2		\$500	Design																																																						
3		\$1,500	Contractor																																																						
4	Replace aging computers and software w/ next generation open architecture systems & components	\$5,100	OP/NET, Consultant & Vendor																																																						
5		\$400	OP/NET																																																						
6		\$500	Consultant																																																						
7		\$3,500	Vendor																																																						
8		\$700	OP/NET & Vendor																																																						
9	Industry collaboration w/ other utilities to develop EM/WQ system for next generation SCADA	\$210	SPS & OP/NET																																																						
10	Develop functional requirements for E/WQ Module	\$180	OP/NET & SPS																																																						
11	Develop specification for next generation E/WQ module for scada systems	\$30	SPS & OP/NET																																																						
12	RTUs will reach the end of their design life and they will no longer be supported by HP (\$2000k/yr)	\$5,000	OP/NET, Design & Contractor																																																						
13	Prevent OP/NET obsolescence by adding & or upgrading hardware and software, upgrading RTUs & com. devices (\$2000k/yr)	\$4,000	OP/NET, Design & Others																																																						

Project: OP/NET System Plan
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Rolled Up Progress

OP/NET SYSTEM PLAN

INTRODUCTION

In the past, migrating to a new SCADA System included replacing the entire system including major sub-components such as the computers, communication medium, and Remote Terminal Units (RTUs). Since the beginning of this decade SCADA vendors shifted from proprietary system design to open architectures. This offers SCADA users, such as EBMUD, tremendous flexibility in upgrading their SCADA Systems. Instead of replacing the entire system as a single project, SCADA Systems can now be replaced by components in a series of smaller but more manageable projects. SCADA migration becomes a process not a goal.

This report discusses how the District can upgrade and migrate to the newer system architectures by implementing a series of projects that will gradually replace the existing OP/NET System and will keep it up to date with new technology.

OP/NET SYSTEM HISTORY

In January 1987, the Board of Directors approved a contract with Fisher Controls for \$15.3M to install the OP/NET System. During the next two years Fisher Controls, their major subcontractor Kaiser Engineers, and District forces worked fervently to install the OP/NET System. The scope-of-work included (See Figure 1):

- the installation of 13 mini-computers at six locations,
- automating two power plants,
- installing 173 remote terminal units and interface panels, and over 5,100 field devices at District pumping plants, reservoirs, treatment plants, rate control valves, chemical plants, and aqueduct wasteways,
- establishing eight Data Acquisition Radios (DARs) with 35 remote radios,
- installing telephone communications to 130 sites, and
- building Pardee Area Control Center.

OP/NET System Plan
December 4, 1996

Since then, the OP/NET System has grown as a result of system expansion and upgrades to a capitalized cost of \$27M. The following highlights the major milestones since the OP/NET System was installed:

- In December 1992 the Oakland Control Center (OCC) and training system computers were upgraded from A900 to the faster A990. The new processors virtually eliminated unexplained system crashes at the OCC.
- In December 1992 the Board of Directors approved a contract for \$1.2 million to install the OP/NET System Capacity Improvement (OSCI) System. This system provides District-wide access to OP/NET data using the District's computer network.
- In December 1993 the District acquired new multiple address system radio frequencies which allowed District staff to expand the number of Bay Area master radio sites from seven to 11. The number of Mokelumne master sites was expanded from 1 to 3. Currently there are 14 master radios. The number of remote radios is currently 65 with another 12 sites coming on-line in the next 5 months.
- In January 1997, a new pump control program will be implemented that will save the District \$75,000 in reduced energy charges by shifting more pumping to a partial peak rate schedule.
- As a result of new facility additions and facility rehab, the number of RTUs has grown to 205 and 23 Programmable Logic Controllers (PLCs). The RTUs and PLCs currently monitor and control over 6,500 field devices.

The OP/NET System has become a valuable asset in managing the Water Production, Treatment, and Distribution Systems. The following are some of the benefits the District is enjoying as a result of the OP/NET System:

- **Reduced Energy Costs** - Without the OP/NET System, the District would not be able to take advantage of Time-of-Use pumping, a lower rate schedule offered by PG&E. The District is saving over \$800,000 per year in reduced energy costs.
- **Historical Data** - The OP/NET System is used by several sections in the District for studies. For example, District staff uses OP/NET data for energy studies to reduce pumping costs, shutdown studies for the Seismic Improvement Project, vibration studies for predicting pump failures and turbidity studies using OP/NET historical data. The Water Distribution Planning Section also depends extensively on OP/NET historical data. Their uses include:
 - Reservoir and system outage plans to trend existing conditions, calibrate models, and forecast performance under different operating and emergency conditions using real-time data.

- Hydrant testing program to incorporate the operating status of related pumping and storage facilities during the time of the testing.
- Pressure zone investigations to help calibrate models with OSCI-based operating data including flows, gradients and pressures.
- Pressure zone capacity evaluation, net zone demand algorithms provide the true zone demand accounting for both pumped flows into and out of each pressure zone as well as the change in storage in the zone.
- Unaccounted water studies (gross vs. net demand) to determine open zone gate leaks.

In addition, historical OP/NET data is also used to meet water reporting regulations.

- **Disaster Response** - The OP/NET System provided critical data on the Distribution System during power outages, the Loma Prieta earthquake, freezes, windstorms, fires, and other disasters. The OP/NET System not only provided information for damage assessment but also minimized service disruptions during and following those disasters.
- **Deferred/Reduced Capital Expenses** - With tighter control of the Distribution System, and better knowledge of actual system demands, the District has been able to defer and reduce capital expenditures. As an example, the Water Distribution Planning Department recently determined that Jensen Pumping Plant did not require expansion.

Despite the many benefits the OP/NET System has and is continuing to provide, there are issues that need addressing to keep the OP/NET System from dying a slow death. These issues include dwindling support and spare parts for key OP/NET components, an obsolete system architecture which will not be supported, proprietary communications, non standard hardware, vulnerability to disasters, limitations on system expansions, and increasingly higher vendor support costs.

CURRENT STATUS OF OP/NET SYSTEM

The OP/NET System consists of several major "sub-systems" which are supported by District staff, vendors, and/or contractors. The following gives a summary of the support issues and problems related to the OP/NET subsystem:

- **Field Sensors and Control Devices** - The OP/NET System uses over 6,500 sensors and control devices to monitor and control District facilities. The complexity of these devices varies from a simple switch monitoring door or hatch cover entry to a complex analyzer for measuring chlorine residuals. Most analog devices, such as pressure transmitters are used to measure pressure, flow, and level. Pressure transmitters, and analyzers use a 4 to 20 mA interface for communicating with Remote Terminal Units (RTUs). The 4 to 20 mA interface is an industry standard and finding replacements for these devices is not difficult.

The District's Electrical Shop maintains the pump controls while the Instrument Shop is responsible for field sensors. Excluding Pulse Duration Modules (PDMs), field sensors do not require a lot of maintenance except for periodic pressure transmitter calibration adjustments

PDM is an old style telemetry system that was installed at key reservoir sites prior to OP/NET. PDMs were tied directly into the OP/NET system, avoiding the initial capital outlay to install RTUs and new field sensors. However, PDMs have proven to be unreliable and require extensive maintenance support from District forces to keep them calibrated and working. In addition there are no spare parts. The OP/NET staff is developing a plan to replace 45 reservoir PDMs with RTUs. Design for this project will start January 1997.

- **Remote Terminal Units (RTUs)** - The RTUs are rugged field computers which serve as an interface between the field devices and OP/NET computers. The RTUs used by the District were made by Hewlett-Packard (HP) and Advanced Logic Solutions (ALS). The HP RTUs are used at pumping plants, reservoirs, rate control valves, chemical feed stations, aqueduct wasteways, and treatment plants, while ALS RTUs are used only at reservoirs.

In 1992, HP discontinued making RTUs and announced that they would continue to support their RTUs for 10 years. Support for HP RTUs is scheduled to expire in January 2002. Typically there are two to four RTU failures per year. The Instrument Shop replaces the damaged component with a spare part after the OP/NET staff "configures" the RTU software. The damaged component is sent to HP for repair which typically takes two to four weeks. HP engineers told OP/NET staff the RTUs were designed for ten years life and that the District should expect to see the number of RTU failures increase as the RTUs age.

Before HP discontinued making RTUs, the District purchased 65 spare RTUs for \$245,000 in 1992. These spares are used to support existing RTU installations and new facility construction. The District has 4 RTUs left in stock for four new pumping plants. At the current rate of construction this should last 3 to 5 years.

The ALS RTU model line was purchased by Basic Measurement Instrument (BMI). These RTUs are used at reservoir sites. They have been exceptionally reliable although the District will lose an ALS RTU every two to three years due to a valve pit flooding. Recently the District purchased ten new BMI RTUs. Future plans for the BMI RTUs are being reviewed by BMI management with the likelihood that they will also discontinue making RTUs.

OP/NET staff is exploring the possibility of purchasing used HP RTUs from utilities who are replacing their systems. There are also other vendors who build RTUs that use the HP protocol. OP/NET staff would only consider this option as a last resort, because of potential difficulties in using another vendor's RTUs with the OP/NET system.

The District is also experiencing problems with the solar cell power systems at six reservoir sites. These systems are either inoperable or loses power during cloudy days. The OP/NET staff plans to upgrade these sites in FY98.

- **Programmable Logic Controllers (PLCs)** - PLCs perform many of the same functions as RTUs. The PLCs are used for power plant, chemical, filter and motor controllers in pumping plants. The District standardized on Allen-Bradley PLCs. The PLCs are used extensively in industry and all PLC models used by the District are still sold and supported by Allen-Bradley. The OP/NET staff has been told by Allen-Bradley that the PLC2 model used at the power plants has been superseded by the PLC5 model. While the PLC2 is still sold and supported by Allen-Bradley, sales are essentially limited to replacement units because newer models provide greater functionality at a lower cost. There could be a two to five day delay in getting a replacement PLC processor if the District needs to replace one of the power plant PLC processors. The treatment plants use the newer PLC5 model so spare parts are readily available.

The PLCs are reliable and failures are rare. The OP/NET staff supports the power plant PLCs while the electrical design group supports the treatment plant PLCs and pumping plant PLCs.

- **Communications** - The District uses a combination of telephone lease lines, Multiple Address System (MAS) radios, and microwave equipment for communications between the OP/NET computers and the RTUs. The District leases their communication circuits from Pacific Bell. The reliability of the circuits varies. Circuits used by PDMs called 1001 lease lines, are being phased out by Pacific Bell.

They are difficult to troubleshoot since they do not have remote diagnostic capabilities. Dwindling support for these circuits is a major justification for replacing the PDMs with RTUs.

Generally older areas tend to have more service disruptions than newer areas. When a communication outage occurs, the instrument shop coordinates repairs with Pacific Bell. Repairs take anywhere between two to 24 hours. The District pays \$240K per year for lease lines.

The District's DAR radio system uses frequencies licensed by the FCC. The District has licenses for 14 DAR Systems which are only used for data communications. Because of the demand for these frequencies, acquiring additional frequency spectrum is difficult. The District was recently offered \$120,000 for two of their licenses.

The original radio system equipment was purchased from Granger Associates. Granger discontinued providing spare parts and support for their radios two to three years after the OP/NET system was installed. The District has since standardized on radios made by Alligator Communications. Although there are some technical complications, radios made by Granger and Alligator can be intermixed.

The instrument shop is responsible for maintaining the radios. The Granger radios are difficult to maintain because there are limited spare parts and the radios use an obsolete circuit design. The OP/NET Section and the Instrument Shop are in the process of replacing the Granger radios with Alligator radios. During the past two to three years of operation, the Alligator radios have proven to be reliable. There are problems with interference from pagers, but pager interference can be minimized by installing special filters on the master radios. OP/NET staff plans to install filters on all master radios as the Granger radios are phased out.

The OP/NET System also uses the microwave which is maintained and operated by ISD. The microwave uses analog technology which is difficult to maintain and support. Like ISD the OP/NET staff is concerned with support issues related to the microwave. These issues are being addressed in the Communication Strategic plan.

- **OP/NET Computers** - The OP/NET system consists of five area control centers (ACCs) located at Pardee Center, Walnut Creek, Orinda, Sobrante, and USL. Each ACC consists of redundant HP1000 A900 mini-computers, redundant 571 mByte hard drives, log printer, alarm printer, two operator workstations, and a plotter.

Each ACC is a stand alone SCADA system which operates independently of each other. Overall control of the distribution system is handled by the Oakland Control Center (OCC). Each ACC communicates with the OCC using Advanced Digital network (ADN) lease lines from Pacific Bell. The District's microwave provides

backup communications. The OCC uses HP 1000 A990 mini-computers which processes information twice as fast as the ACC's HP 1000 A900 computers. The OCC has 1,713 megabytes of disk storage, three times the storage capacity of the ACCs.

The OP/NET Section provides system administration for the OP/NET computers. Their duties include performing quarterly tape backups, managing system upgrades, executing system diagnostics, and troubleshooting system problems. The District also has a maintenance agreement with Associated Process Controls (APC) for hardware and software maintenance. APC in turn subcontracts the hardware support to Ideal Computer Services and software support to Fisher Controls.

The annual contract with APC is \$200,000. APC's support includes:

- Quarterly preventative maintenance and inspection visits of the ACCs and OCC,
- Hardware repairs for the computers and peripherals which includes labor and parts,
- Software maintenance which includes quarterly on-site visits by a Fisher Programmer to fix problems which cannot be resolved from their offices in Marshalltown, IA.
- Operating system upgrades from Hewlett-Packard (HP).

HP has agreed to support the HP 1000 computers and the RTE operating system until the year 2010. Fisher Controls, the developer and integrator of the OP/NET System software announced that they will not renew software maintenance agreements beyond the year 2000.

For the most part, the OP/NET system has been very reliable with average up times running above 99.9%. Because of redundancy in the OP/NET system design, a component failure usually does not take the system off-line. Electric power is conditioned by Uninterruptible Power Supply equipment which is backed up by on-site batteries and standby generators.

The components which are starting to fail includes the operator workstation monitors, operator workstation video cards, and disk drives. The disk drives, which have been in operation for eight years, are nearing the end of their design life. Several disk drives at the ACCs and OCC have been replaced.

The software is stable. The number of software trouble reports ranges from zero to two. The number of software problems typically jumps up following an operating system upgrade. Fisher takes about a week or two to fix problems related to the operating system upgrade.

- **AIMAX** - The AIMAX process control man machine interface (MMI) runs on a 486 compatible IBM PC. AIMAX provides an operator interface for process control of the filters, chemical feed, and ozone facilities at all of the District's water treatment plants. Although not part of the OP/NET System, the OP/NET staff, and instrument shop supports the system. In addition to in-house support, the District has a annual contract with TA Engineering, the developers of AIMAX, for \$8,000 per year.
- **OSCI** - The \$1.5 million OSCI project was approved by the Board of Directors, December 1992. CIM/21 software, from Aspen Tech (formerly Industrial Systems, Inc.), became operational in late December 1993, and has reliably been archiving OP/NET process data with near real-time resolution (10 second update interval). The OSCI project has provided the following benefits:
 - Desktop access to OP/NET process data: Data access and usage (by personnel other than operators) has increased 100 fold. OP/NET data is now accessed extensively by Planning, Design, SIP, Mechanical and Instrument Maintenance, Aqueduct, SWQ, TSD, and others for real-time operations and historical analysis. Over 100 users have been trained.
 - ACCs could previously only view OP/NET data specific to their local geographic area; OSCI now provides a window to the entire system. Trends also have higher time resolution, faster recall, and have been on-line since Jan. 1, 1994.
 - OSCI provides easy access to the OP/NET data residing in the Oracle database.
 - OSCI provides an easy way to export process data to PCs for further data analysis in spreadsheets and models and minimizes rekeying of data.
 - OSCI also provided improvements to the Wide-Area Network (WAN) and extended Local Area Networks at all the ACCs, treatment plants, and Stockton. These WAN improvements allow users at these location to access Office Vision, Novell file servers, LIMs, Internet.

- OSCI has reduced loading on the OCC HP1000 computers. These computers were nearing overload. The OSCI historical trending package works much faster and is much more flexible and extensible to process data than the original trend capabilities. The HP1000 reduced loading provides more capacity for adding new tags and site additions. OSCI can also embed trends in the Process Graphics.
- OSCI has provided improved maintenance response by the OP/NET engineers, Instrument Technicians, mechanics, and Fisher Controls programmers.

Some additional items such as:

- additional memory for OSCI workstations, additional disk storage,
- new CIM/21 software modules for ODBC PC access,
- another workstation for HP-Open view and hardware backup are being purchased to expand and allow continued growth of the OSCI system. The new CIM/21 software modules will provide standards-based connectivity calls such as ODBC for more transparent and automatic OSCI data extraction to client databases and models and report generators. The PC/21 modules allow integration of OSCI data directly into an Excel spreadsheet bypassing the steps for exporting data. PC/21 also provides users the capability to save their own tag lists and improved remote access speed.
- The OP/NET staff supports the OSCI computers and Network System. In addition the District has \$ 35,000 annual contracts with HP for maintenance support and a \$22,000 Annual contract with ASPEN. The system uses the latest client server technology.
- The OSCI pump control project (additional \$230,000) will provide a "next generation" pump control program. The new pump control will provide an order of magnitude increase in flexibility over the original OP/NET pump control and also provides many time saving features for the operators. The new pump control expands the capability to minimize pumping during the shoulder periods and improve water quality and Red Flag response.
- OSCI Future: OSCI should continue to provide access to the process data across the District after the original Fisher Controls GV1000 OP/NET is replaced. Aspen Tech has been aggressively evolving the CIM/21 product.

In one or two years, the evolved product may warrant a review as to potential to replace OP/NET. Additional custom modules will be needed. A more robust reconfiguration, allowing the ACC OSCI workstations to operate "stand alone", may be warranted for improved disaster preparedness. Any OP/NET replacement system should be able to communicate with CIM/21. There are some major security benefits to maintaining separate control systems and process data archives.

EMERGING TRENDS

As with all systems that rely on communications and computer technology, SCADA systems continue to evolve resulting in lack of support and obsolescence of existing systems. The following highlights the current situation and emerging trends in the SCADA market:

- **Field Devices** - 4 to 20 mA current loops have been the standard interface for field devices during the past 20 years. Although this standard has served the industry well, there will be a migration from analog devices to digital devices during the next several years. The driving forces for this change include reduced wiring, remote troubleshooting, greater accuracy, and more features such as internal diagnostics. The lack of standards has slowed the progress of digital based products, but this will change as the Instrument Society of America (ISA) and Industry consortiums finalize the field bus standard. Currently neither the OP/NET System computers nor the RTUs support the new field bus standard.

As an interim solution, Fisher-Rosemount introduced a hybrid communications protocol called HART that supports analog and digital communications. The HART protocol has become a defacto standard and is currently used in products ranging from pressure transmitters to process analyzers. The District has a pilot program using HART based pressure transmitters. The HART transmitters do not require an RTU, therefore significantly reducing the cost and time to install a monitoring point.

- **RTUs** - Many of the newer RTUs provide capabilities that are not available with the HP RTUs. These capabilities include:
 - Powerful programming features that are easy to use - Most of the District's pumping plants use relays for pump control. However, right after the OP/NET System was installed, the District began a pumping plant rehab program which replaced the relays with Programmable Logic Controllers (PLCs). Although many of the features and functionality of the PLCs and RTUs overlapped, the RTUs did not provide adequate resources for doing the pump control in the RTU and the PLCs provided limited SCADA communications. Consequently there are several pumping plants which use both an RTU and a PLC.

The newer RTUs and PLCs have overcome these limitations and pump control and RTU functionality can be combined in a single package. This would reduce the costs of new installations and pumping plant rehab as well as lower maintenance costs. District staff would only need to configure and maintain one device.

- Multiple communication protocols - Communication protocols define the way a RTU talks to the SCADA computer. ModBus has become a defacto standard for SCADA communications. This is an older protocol and lacks the features of newer but proprietary protocols. Currently there are several industry trade groups working on a standard, but they are several years away from adapting a formal standard.

The District's RTUs use the HP protocol. Since HP no longer manufactures RTUs, there is little support for the protocol, although a couple of RTU vendors do provide RTUs with the HP protocol.

The new RTUs provide a selection of several popular RTU protocols. Some RTU models can even load newly developed protocols. These features make newer RTUs more flexible and "open" than the District's HP RTUs.

- Additional communication interfaces - RTU interface or ports provide a connector to the telephone company or radio system. There are a variety of RTU interfaces but they can generally be grouped as serial, modem or network interfaces. Network interfaces are used for communication within a building and are not used for communicating with remote facilities.

The ALS RTU uses a 202T modem interface. The 202T was a popular SCADA communication interface, but this standard is giving way to faster modems and serial interfaces. The Bell 202T modem is difficult to link to newer communication links such as the telephone Advanced Digital Network (ADN) and the newer digital radios.

The HP RTUs have two ports; a 202T and a serial port. The serial port provides more flexibility in communicating with newer technology offered by the telephone company and radio vendors. Both ports are used at critical facilities where redundant communications are required to increase communications availability. The newer RTUs have additional ports that support more than two communication channels.

- More input options - Some of the new RTUs support HART and Field bus devices. Using field bus devices could save the District money by simplifying new facility designs and reducing wiring costs. Because of the proprietary nature of the protocol and hardware used by the OP/NET computers, RTUs, the current OP/NET system will not support emerging communication technologies.
- **Communications** - During the past decade there has been a shift from analog to digital communications. The driving force behind this shift is the trend to faster and more reliable communications. Digital communications, which transmits data in a stream of ones and zeros, is less prone to noise than analog communications. Analog communications use a continuously varying electrical signal for transmitting information. This signal is easily corrupted by expanded noise sources. The resistance to noise explains why digital based Compact Disks (CDs) quickly replaced analog records as a means for reproducing music.

Unlike the District's analog radio system the current generation of Multiple Address Systems (MAS), transmit data using digital modulation techniques. Not only do these techniques improve transmission reliability they also increase data rates by a factor of 4 to 8 times. Because of technical limitations with the District's microwave system and RTUs, there are no plans to upgrade to digital radios in the near future.

The telephone company is also migrating to digital communications with their Advanced Digital Network (ADN). This type of circuit will accommodate data rates up to 56 kbps.

While the District is using ADN circuits for ACC to OCC communications, adapting ADN for RTU communications is more difficult, subsequently the OP/NET staff does not have plans for developing ADN circuits for RTU communications. Fortunately the analog radios currently purchased by the District can be upgraded to digital radios.

Future trends are difficult to predict because of the major changes taking place in the telecommunications industry. These changes are driven by the recently passed telecommunications net and emerging technology such as the internet. One SCADA communication expert suggested that satellites will play a major role in SCADA communications in 5 to 10 years.

- **Client/Server Technology** - Client/Server Technology was developed for integrating main frame, workstations and personal computers using networks. This type of architecture leverages the strength of each type of computer system to achieve a high performance system at a reasonable cost. For example, main frames provide hardware redundancy, more reliable disk drives and better diagnostic tools, whereas workstations and personal computers cost less and perform resource intensive task such as graphics and modeling.

Typically main frames and workstations are used as servers because of their ability to quickly retrieve and send data when requested by a client. The client, which is usually a personal computer, formats and displays the data from the server.

About a year after the OP/NET system was installed, vendors started to release SCADA systems based on the client/server architecture. Today all major SCADA systems employ client/server technology.

In addition to cost and performance, portability is another major factor on why client/server technology is so widely adapted by utilities. Portability means that SCADA software can run on different hardware platforms using different operating systems. This means that a SCADA user is not locked into a particular hardware platform, or a SCADA software vendor.

This provides several benefits which are not available with the current OP/NET system. These benefits include:

- Scalability - This means that computer hardware can easily be upgraded or added to accommodate system growth.
- Multiple Platform Choices - SCADA users are no longer locked to a particular computer vendor. They can select their computer hardware based on cost or service since most SCADA vendors support multiple computer platforms.
- Multiple Software Choices - A utility can now replace or upgrade their SCADA software without replacing existing hardware.

By migrating to a client/server architecture the District can gradually replace and upgrade SCADA hardware and software without investing large sums of capital funds. Improvements and replacement of obsolete components becomes a process rather than a major project.

PLAN TO ADDRESS OP/NET OBSOLESCENCE

To achieve the benefits of a client/server SCADA system the OP/NET section recommends shifting to a continuous replacement and upgrade process that can be funded as a baseline cash flow.

Starting in January 1997 the Electrical Design group and the OP/NET section will start the design work for replacing the Pulse Duration Modules (PDMs) with RTUs and replacing the Granger Radio with Alligator. The BD-1 for the PDM replacement project will be issued the first quarter of FY98 with construction proceeding for the next 18 months.

As a parallel activity the OP/NET section will start the process of replacing the ACC and OCC computers with client/server technology. A tentative schedule is shown in Figure 2. The design will be based on the assumption that the client/server will communicate with the existing HP and ALS RTUs. Once the client/server SCADA system is in place the OP/NET section will start a five-year program to replace the RTUs and if necessary, the field devices. They will also upgrade the hardware and software of the client/server computers to take advantage of new technology.

This plan will shift the focus of replacing the OP/NET System from a goal to a process. Rather than gearing up for a major replacement project, this plan will spread the workload by implementing a series of smaller projects by replacing OP/NET subsystems instead of the entire system.

BENEFITS - PROPOSED PLAN

The benefits of the proposed plan include :

- System will be based on an open or standards based architecture which can be continuously upgraded thus avoiding obsolescence and balloon payments.
- No additional staffing is expected for the implementation and installation of the system.
- New equipment and software could be field tested, enabling system enhancements that make the most sense.
- Operational disruptions would be minimized as OP/NET streamlines the procedures and methods over time.
- Operators would better understand the new system and thus be better equipped to offer suggestions to operate the plant more efficiently.
- Maintenance personnel could field test new instruments for reliability in pilot study programs.
- Disruption from disaster recovery programs would be minimized.

PERSONNEL ISSUES/STAFFING

New system installation requires tremendous effort during the early phase. To minimize costly operational disruptions and utilize a flat staffing plan, the installation process needs

to be phased in gradually. Engineering, Operations, and Maintenance need to work together to ensure success.

Engineering support is needed for power calculations, designing new equipment housing, layout, and as-built drawings for the new equipment, and RTU installation design.

Maintenance support is needed for the field work, such as installing new instrumentation, new equipment, new power hookups, and re-wiring as necessary.

Currently the OP/NET staff has been supporting the Water Operations Network. Some of this support will need to be shifted elsewhere while OP/NET staff maintains the existing OP/NET and OSCI System and installs the new OP/NET System.

Operation support is needed for providing outage coverage during the startup and shake-down periods of the new system.

COORDINATION WITH OTHER DEPARTMENTS

The startup period of a new system is the most complex part of the whole process; this is where coordination and cooperation between different departments is essential to the success of the process.

The different departments involved must have the same priorities and the field personnel must be committed full-time to the project.

In order to promote cooperation, information and correspondence should be shared with all involved departments through linking-pins and project status meetings.

ALTERNATIVES

The two major categories of alternatives are to either to do nothing or to do the work in a \$12 Million two-year project. Discussion of these two options will reveal why neither is as desirable as the recommended plan.

- **Do Nothing** - As the various parts of the OP/NET System reach the end of their vendor's support, the District's cost of maintenance will increase until components fail and are not replaceable at which time that part of the system becomes inoperable.

Consequently, in the short run, maintenance costs will increase, staffing costs will increase, and savings (i.e. the \$800,000 per year for pumping during the cheapest TOU electricity cost rates) will no longer be possible. In the long run, the system or key components will be inoperable. In this case staffing increases will be needed.

The water distribution system used to be operated by a staff of 25 in trucks who visited the pumping plants to manually start or stop pumps.

- **\$12M Two-Year Project** - The Water Operations Information System's Strategic Plan finished by EMA in 1994, recommended hiring a consultant to assist the District in pre-design, design, and implementation of the OP/NET System migration in FY99. EMA's Life Cycle estimate was a project from 5 to 12 million dollars and they used \$12M for their cost/benefit analysis.

Since that time, Fisher-Rosemount has modified the end date of their software support to extend to April 2000. Consequently, the replacement could take place in FY99 and FY2000.

Installing the new system will be different from the original OP/NET System installation in that at that time no prior system existed which had to be kept operational. The engineering and operator support staff then could dedicate full time to training, testing, and startup. This will not be possible at the turn of the century because this staff will have to also keep the original system operational. Consequently, increased costs of overtime and personnel stress would be involved if the project were done in a concentrated two-year period.

The cash flow for the District would be more drastic if the entire \$12M had to be disbursed in a short two-year time period.

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